# /CHANGES IN CONTEXT AS A MEASURE OF SEMANTIC FLEXIBILITY/

by

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Semantics, the study of meaning, has long been of interest to philosophers and linguists. Psychology has also examined meaning, focusing on issues such as context-dependency, class/category inclusion, similarity, typicality, and verification/contradiction. The plethora of reaction time studies (the most common method used) has yielded a wealth of data, and semantic theories have been developed to describe and explain these data (e.g., Collins & Quillian, 1969, hierarchical-network model; Meyer, 1970, predicate-intersections model; Smith, Shoben, & Rips, 1974, feature-comparison model; Glass & Holyoak, 1975, marker-searcher model).

Throughout this research, with its emphasis on features, context, and knowledge of the world, there seems to have been a tacit understanding that, for any given word, meaning is static and fixed. This assumption underlies current network and hierarchy models. However, there have been a few attempts, by psychologists working with polysemy (e.g., Anderson & Ortony, 1975; Barclay, Bransford, Franks, McCarrell & Nitsch, 1974), to break free from this notion. These studies have shown that even unambiguous words vary in the way in which they are interpreted. Meaning, as it

occurs in human language, is in constant flux, as can be most clearly demonstrated by neologisms, metaphor, and our constantly changing lexicon.

An apparent corollary to the idea of static meaning seems to be the idea of discrete semantic components. These components, or features, as they are termed in semantics, are typically defined as atomic descriptions of aspect, attribute, orientation, and relation (or some combination of these). Seen another way, these semantic primitives are basic units of information and therefore the building blocks of meaning. To say something is atomic is to imply that it cannot be broken down into further components. This idea is a clear example of atomism. That is, that there exists a set of semantic primitives, nondecomposable features which combine to create our understanding of meaning (e.g., the meaning of a word such as "man" may be defined through the use of indivisible attributes such as [+animate], [+human], [+male], [+adult], etc.).

Unfortunately, much work done on semantics in linguistics (e.g., Bollinger, 1965) seems to assume that features, by virtue of being atomic, must therefore be discrete. That is, if we suppose that

there exists some feature on the order of, say, "animation" (i.e., [+/- animate]), current theory seems to imply that either the feature is there or it is not, that either an item is animate, or it is not, i.e, a simple binary choice. This is intuitively appealing, even quite obvious, but only on the surface.

While we may look at an item and be able to say with some certainty whether it is or is not animate, all items which we declare as animate are not necessarily understood to be so to the same degree. These differences can be described in terms of either typicality (Smith, Shoben, & Rips, 1974) or fuzzy class membership (Oden, 1977), but the idea that atomic features must be discrete is called into question and must be reexamined and amended. In fact, Smith et al (1974) have begun to do so with their feature-comparison model.

This model splits semantic features into two groups, those features which may be said to be defining, i.e., essential to a word's meaning, and those features which are merely characteristic of the meaning of a word. Example: for the word "bird" the feature "flies" would be a defining feature, being seen as a necessary aspect of "bird;" on the other hand, a

feature such as "sings" would be a characteristic feature, not a requirement of "birdness." This distinction is a bit strained, as the boundary between these two types of features is never sharply defined, and in fact is often rather arbitrary. Still, the idea that features, whether defining or characteristic, may be more or less present in a word is a beginning in the direction away from the notion of a mandatorily discrete atomism.

In a similar vein, Oden (1977) has demonstrated that class membership cannot be simplified into "yes/no" dichotomy. Rather, some members of a class are readily perceived as better exemplars of the category than other members. For example, while items such as "table" and "chair" are certainly members of the class "furniture," other items such as "lamp" or "mirror" are also viewed as members of the that class, but not as strongly or to a lesser degree. The notion of fuzziness and subjective categories is still another example of viewing meaning as a continuum, rather than a series of discrete intervals.

In a series of four elegant experiments using cued recall, Barclay et al. (1974) examined the influence of context on the semantic flexibility of words. While

pointing out that researchers had for years been emphasizing specific attributes and aspects of word meaning to establish the dimensions necessary to test their own semantic theories, e.g., hierarchical organization (Collins & Quillian, 1972),implicit associative responses (Underwood, 1965), or imagery (Paivio, 1969), Barclay et al. examined this selective focusing of interpretation by observing the effect of appropriate vs. inappropriate cues on the recall of unambiguous nouns. Their findings suggest that the interpretation of a word varies as a result of its sentential context. That is, the internal representation, the meaning or psychological instantiation, which we create for a word is a product of the context of the word as well as of the word itself. Even an unambiguous word must be disambiguated from its many and subtly different interpretations, and this disambiguation can only come about by incorporating the contextual information into our understanding of the word. Barclay et al.'s (1974) example clearly illustrates this point:

> "Consider, for example, the way in which one's interpretation of the unambiguous noun piano is affected by verb selection in the

following sentence frame. The man (lifted)(tuned)(smashed)(sat on)(photographed) the piano. It seems intuitively that various properties of piano are differentially emphasized as a function of the event described." (p. 472).

Indeed, the piano described in each of the events above is at once both the same yet a different piano from all of the others. Barclay et al. demonstrated that sentential context influences the interpretation of nouns by stressing specific attributes of these nouns. They go on to "suggest that the contextually determined relevance of each of a word's semantic properties is somehow indicated in the encoded representation of that word." (p. 479).

Barclay et al. concluded by providing a warning for further research, a warning largely ignored in the decade since, that concentration and overemphasis on fixed aspects of meaning have produced a blindness to the more realistic notion of semantic flexibility. This leads to the incorrect assumption that the same internal representation of a word is activated, regardless of the context, whenever the word is used.

Some research has avoided this pitfall. For example, Thomson & Tulving (1970), using their encoding specificity model, have demonstrated that "the effectiveness of retrieval cues depends upon the specific format of the to-be-remembered (TBR) words at the time of their storage, regardless of how strongly the cues are associated with the TBR words in other situations." (p. 255). That is, the associations which are present during the presentation of a word will in turn provide the most powerful cues for later recall. Associations are perhaps the most obvious aspects of context, allowing us to relate the word to other elements in the environment. For example, the word "doctor" conjures up strong associates such as "nurse" and "hospital," though these associates are clearly not part of the meaning of "doctor." The emphasis in an encoding specificity model is on the relationships which exist between the word and its environment, and not upon the effect the context has upon any internal representation we may form of the word. For example, attributes such as "skilled" or "knowledgeable" might be part of an internal representation of the word "doctor" but which are not external components provided by the context.

Barclay et al. go beyond this, however, suggesting that more is at work than encoding specificity; that it is rather the whole which in turn affects the nature of its parts, that the manner in which a noun is instantiated is determined by the relevance or salience of each of its semantic properties to the situation, as defined by the context (see "piano" example above). Crucial to our understanding here is a distinction between associations on the one hand, and attributes on the other. While relations of association may be supported by a model of encoding specificity, such a model does not necessarily extend to the actual attributes which make up a word's meaning. The nature of Barclay et al's piano described above does not change as a function of context, nor do its associations. What does change is our perception of the piano itself, the relevant and salient aspects, the attributes, which make up our understanding of the object, whether as a musical instrument, a heavy item of furniture, etc. In this light we see that it is the context which cues which of a word's semantic properties are to be incorporated into the internal representation, and to what degree.

In a recent study, Greenspan (1984) demonstrated a distinction between what he called central and peripheral attributes of word meaning. Central properties he describes as "those properties which are typically central to our experiences with the object," while peripheral properties "are properties which tend to be peripheral to our experiences." (p. 2). For example, music is a central property of piano, while heavy is a peripheral one. At first glance these may appear to be rather trivial and obvious distinctions; however, Greenspan's results suggest that central properties of a word are active in our understanding any time the item is experienced. This is not the case with peripheral properties. Greenspan has demonstrated that priming experiments utilizing peripheral attributes produced results in line with an encoding specificity model, i.e., recall of the target word was significantly better when the peripheral cueing attribute was primed as compared to its use as a cue without priming, or with different priming. However, Greenspan's results using central attributes as cues were quite different. In the case where central attributes were used, recall of target words was not significantly different whether the cue was

appropriately or inappropriately primed. Once again this suggests that an encoding specificity approach is considerably limited with respect to the study of meaning, or more specifically semantic flexibility.

It is curious that this idea of semantic flexibility has, until quite recently, been all but ignored in the literature, and that the notion of discrete, as opposed to continuous, semantic features is still commonly accepted. An encouraging exception to this is the composite holographic associative recall model (CHARM) developed by Eich (1982, 1985). In this model Eich describes the link associating two items in memory as the semantic overlap of shared features and the respective weights of these features, and uses this link to examine the processes of storage and retrieval in memory.

As a final note to their 1974 paper, Barclay et al. suggest that some theory or method of weighting semantic features, or selectively activating some features over others, or perhaps both, would be needed to adequately describe such of semantic flexibility. It is just such a theory which is presented below.

The assumption that semantic features exist on a continuum is part of the foundation of a proposed new

approach called Variable Feature Theory. The flexibility provided by such a continuum cannot be overstressed. The influence of each feature may be scaled in terms of its salience to the item's meaning, permitting in this way the finer and finer shades of meaning which language is capable of. However, Variable Feature Theory posits not only semantic features which exist along a continuum of salience, but also features with the ability to move along this continuum within a word as the situation demands. The salience of features are always in flux, and it is the combination of all of these variable features, and their relative saliences, which makes up our understanding of a word.

To make use of Barclay et al.'s "piano" example again, the aspects of meaning which are particularly salient to the interpretation of the word are provided by the context; this contextual information determines which features of the word are salient, and to what degree. Those features which are relevant would increase in their value of salience, while those features less essential to the immediate meaning of the word would decrease. For example, the feature "heavy" is relevant and therefore salient in the sentence "the

man lifted the piano" while it has little or no importance to our interpretation in a sentence such as "the man tuned the piano." With this in mind, it is easy to understand that the immediate meaning of one concept (the meaning intended at a particular time, in a particular context) interacts with and alters the immediate meaning of other concepts that it encounters whether from the environment or through use. This is not a new idea, being in many ways a restatement of Barclay et al. (1974) above. What is new is the notion that these changes occur as a result of changes in the salience of component features as they move along their respective continua.

In summary, our understanding of a word is colored by recent or current context. This does not seem particularly earth-shattering; in fact it is quite intuitive, but it is precisely the sort of real-life phenomenon a theory of semantics needs to be able to describe.

In one of the few studies to focus on such "real-life" aspects of semantics, Tabossi (1982) examined just such phenomena in her investigation of how context facilitates interpretation. Her study addressed the question of whether the meaning of a

word, drawn from a sentence as a whole, results from the salience of a particular aspect of the word's meaning. Tabossi presented her subjects with a brief phrase which highlighted a specific attribute of a target noun, i.e., raised the salience of a particular feature. Half of these phrases used verbs which contained selection restriction cues, that is, the verbs reflected some aspect of the subject noun, (e.g., "the fire warmed the soldiers in the winter"), while half the phrases used verbs without any such restrictions or special relations to their subject nouns (e.g., "the fire protected the soldiers"). After reading each sentence, the subjects performed a verification test. Half of these verifications were designed to elicit priming effects from the earlier phrases, that is, they contained the attribute implied by the phrase (e.g. "fire is hot" for both the phrases given above), and half the verifications irrelevant, unprimed attributes of the phrase's target word (e.g., "fire is bright").

Tabossi compared the reaction times gathered from the verification tasks and found a reliable difference between primed and unprimed conditions. Tabossi's study demonstrated "that a question about a noun is

easier if it is preceded by a sentence which primes a relevant semantic characteristic." (p. 87). This is consistent with the Barclay et al. results of appropriate and inappropriate cued recalls, and reaffirms the importance of context in our understanding of meaning. The results suggest that, rather than utilizing all possible information concerning a word, in all uses of the word, only specific and relevant aspects of its meaning are used for interpretation.

The current studies are an attempt to go somewhat beyond the atheoretical limits of Tabossi (1982). While Tabossi demonstrated that the sentential environment of a word provides the information we use to generate its meaning, she did not make any suggestions as to how this process occurred. It was the goal of the current studies to do just this. Variable Feature Theory suggests a manner in which semantic features may move along a continuum of salience, altering the meaning of a word as they rise and fall in relevance to that word, depending on the context of its use. As semantic features are purely a theoretical notion underlying our language, we cannot manipulate them directly. Instead, this study uses

attributional norms of words with the assumption that these attributes, being descriptive properties of the words, can serve as measurable representations of semantic features. While this assumption is tenuous, it is not unwarranted. Indeed, it is a long standing precedent in linguistic theory to conceptualize semantic features in just this way (Leech, 1974). With this assumption, we could then manipulate these attributes, rank them for salience in various contexts with respect to the same word, and observe the resulting changes in meaning.

Three main improvements over the Tabossi study were intended. First, whether for reasons of simplicity or as a result of the binary tendency discussed above, Tabossi's design looked only at pairs of attributes for each word, and pairs of primes for each attribute. Accepting the notion of semantic features existing upon a continuum, the current studies required at least three items being examined to demonstrate this middle ground. This has been included. Secondly, Tabossi's results are based on a small number of subjects (16) split into two groups, each producing a total of thirty-two data points for their respective conditions. These numbers seem

somewhat inadequate, the more so with the inclusion in this experiment of varying levels of salience, where subtler changes in meaning need to be detected. Finally, the current studies adopt a more theoretical context, attempting to relate recent results with contemporary theories and procedures.

This research was intended to establish certain relationships between words, their attributes, the salience of these attributes as a result of specific contexts, and the way in which our processing of these words changes as a function of the salience of each word's attributes. Experiment 1 gathered some attributional norms for a small group of nouns (with the assumption that these attributes can be used to represent semantic features). Experiment 2 demonstrated that the norms, as found in Experiment 1, are ranked differently in terms of salience in different contexts. Finally, Experiment 3 was intended to illustrate that these rankings, which reflect contextual changes, affect our internal representation, the meaning, of the nouns.

## EXPERIMENT 1

### Method

Subjects. Forty students from General Psychology classes participated and received partial credit toward a course requirement.

Design and Materials. Words were selected for this task from the list of 1000 nouns compiled by van der Veur (1975). The words were selected on the basis of imagery rating, a scale which ran from one (low imagery) to seven (high imagery). For the purposes of this study and as a consequence of time constraints, only those words with a mean imagery rating above 6.0 were used, based on the assumption that subjects would generate more attributes in a shorter time period for high-imagery items than for low. From these words a list of 54 words was derived, after having been rated as both concrete and unambiguous by a panel of three general psychology teaching assistants (see Appendix A). 50 of these words were used for the task in this experiment; the remaining four words were used as examples in the instructions.

Procedure. The student subjects were informed that they were part of an experiment to establish attributional norms for a list of nouns. They were

presented with a set of instructions, as well as one of two lists of 25 high-imagery words. The subjects were requested, via the written instructions, to write as many characteristic properties of each word on the list as they were able, being further requested to attempt at least four such terms per word. Four sample words were provided, with appropriate properties written in. The instructions included a clear distinction between "attributes" and "associations," defining the former as those properties which were considered prototypical or innate to most or all instances of the word, and the latter as properties which only occurred for a few or specific instances of the word, often only in special or limited context. The experiment instructions read:

> The goal of this experiment is to gather as many characteristic properties for these nouns as possible. These properties are the words we use to make up the meaning of other words. For example, characteristic properties of the word "fire" would include "is hot," "is bright," "burns," etc. These are attributes of the word "fire" and make up our understanding of its meaning. In the pages that follow please try and write four or more

such attributes for each word. Remember, an attribute is a characteristic property of a word; it describes an innate aspect of the word, something which is typically a part of that word's meaning. Do not confuse these attributes with "associations." Associations are properties or ideas which are related to a word, but are not a part of its meaning. Example: All of the properties described above are a part of the word "fire," they are attributes of the word; an association for "fire" might be "what happens when I light a match," or "what burned down my house." These examples are not innate properties of all or even most fires, they are only things we may "associate" with fire, or even with a specific fire. Attributes, on the other hand, apply most or all of the time.

Subjects were then given approximately twenty minutes to generate these characteristic attributes for the 25 words; they worked at their own speed.

Results and Discussion

The attributes generated by the subjects were then tabulated in the following manner. A list of every attribute produced for each of the 50 words by all of the subjects was compiled. Where more than one instance of an attribute occurred (the most common case) a tally was made of the frequency of the term. These 50 lists were then further condensed by treating synonymous (as judged by the experimenter and two undergraduate assistants, requiring two-thirds agreement for synonymity) attributes, between subjects, as identical, simply increasing the frequency of the appropriate attribute. Example: synonymous attributes for the word "elephant" such as "large" and "big" produced by different subjects were considered separate instances of the same attribute and were recorded as two entries of "large."

After establishing the attributional norms and their relative frequencies for each of the 50 nouns, a list of 18 nouns was then derived for Experiment 2 (see Appendix B). This new list was composed of those nouns possessing at least five attributes, each of which was produced by at least sixty percent of the subjects (see Appendix C). In the cases where more than five such attributes were available, the top five attributes (in

terms of frequency) were selected. These materials were then used in Experiment 2 to establish the ranked order of salience for each set of five attributes in each of three different contexts.

## EXPERIMENT 2

### Method

Subjects. Sixty subjects from the same subject pool as used in Experiment 1 participated in one of three groups of twenty individuals each.

Design and Materials. Based on three of the five high-frequency (sixty percent or higher) attributional norms established for 18 of the nouns from Experiment 1, contextual priming phrases were created for each noun (see Appendix D). Each of the three phrases for each noun emphasized an aspect of the noun's meaning which was exemplified or directly related to one of the noun's five attributes. In other words, short sentences which focused on a single aspect of each word's meaning were produced for each of three of the noun's five attributes (as produced by Experiment 1). Example: sentences for the word "elephant" might be "the elephant filled the room," "elephants are drab looking," and "the elephant squirted water" emphasizing

the attributes "is large," "is grey," and "has a trunk," respectively.

The three (out of five) attributes used in these phrases were chosen by the experimenter on the basis of diversity, that is, the three attributes were selected to provide as wide a range of context as possible when used to create the phrases. All three phrases for each of the 18 nouns were reviewed and acknowledged as actually emphasizing the indicated attribute by a panel of four graduate students in cognitive psychology who, when presented with the noun and sentence, responded with the appropriate attribute.

The 54 phrases were then divided into three lists, such that no list contained the same noun more than once. That is, each of the three phrases produced for each noun was in a different list. Testing materials consisted of sheets with each noun, a priming phrase for that noun, and the noun's five attributes presented respectively. For example, referring back to the example with "elephant" used earlier, the noun is "elephant," the phrase "the elephant filled the room," and the attributes would be "is large," "is grey," "has large ears," "has a trunk," and "has tusks." The order

of each subject's 18 exercises was randomized, as were the order of the five attributes within each exercise.

Procedure. The subjects were presented with the described materials and were asked to read the noun, the phrase, and five attributes, and then to rank the attributes (for that context) in terms of salience by numbering them one through five, with one being most important or salient, and five meaning least important or salient. Several sets of sample nouns, phrases, and attribute lists were provided as examples and had been pre-ranked to illustrate to the subjects how to perform the task (see Table 1). Materials were organized such that no subject received the same noun more than once, that is, the subjects in each of the three groups received only one of the three context phrases for each of the nouns. Subjects worked at their own rate and performed this task on each of the 18 nouns provided.

Results and Discussion

A two-way analysis of variance was performed for the three levels of context and five levels of attributes for each of the 18 words. No main effect of context, nor a context x attribute interaction could be determined, due the nature of the measure which required subjects to rank attributes using values one

through five, by definition summing to fifteen in every context. The analysis focused on the main effect of attributes. Significance levels of at least $p < .05$ (see Tables 2.1 through 2.18) were found for 16 of the 18 words, with remaining two words approaching significance at $p < .08$, providing clear support for the intuitive notion that context produces changes in the salience of the individual aspects of meaning.

Averages of salience ratings for each attribute of each phrase were then obtained by collapsing across the twenty subjects for each group. The average saliences of the attributes in each of the 54 phrases provides a crude measure of the relative ratings of the variable features these attributes may be said to represent. Specifically, the presentation of each phrase provides a context for its respective noun, a context which specifies a unique meaning for that noun from other contexts (see Tables 2.1 through 2.18). This uniqueness is shown by the change in ranking of the attributes for each noun across three different contexts (as provided by the phrases). That is, the change in ranking reflects a change in the understood relative salience of the five attributes, which may be conceptualized as components of the noun's meaning.

The idea that meaning is not static but rather fluctuates is thus clearly and simply demonstrated.

## EXPERIMENT 3

This experiment was intended to demonstrate the effect of meaning on reaction time as a function of context. An inherent assumption in studies treating meaning as static is that the reaction time to verification questions will likewise remain constant across contexts. That is, that regardless of which primes or cues are used, subjects will respond at a constant rate. Such results might be explained in terms of Greenspan's central properties, which appear to be active whether specifically primed or not. However, assuming semantic flexibility (as demonstrated in Experiment 2 above) as the norm, a variable set of reaction times would be anticipated, with the swifter reaction times corresponding to the more salient attributes as appropriately primed by each context.

Studies of semantics which make use of reaction time measures do so with the understanding that the amount of time required reflects the operation of some cognitive processes, such as spreading activation through relevant pathways of a network or searches through some form of semantic hierarchy. Variable

Feature Theory suggests that the paths traced in such a network or hierarchy are determined by the salience of the components or attributes which create our understanding of a word, as determined by context. In a verification situation, it is predicted that swifter reaction times would result where the salience ratings of the attributes of the word, as provided by the context of the priming phrase, most closely matches the salience ratings of the attributes of that word as produced by the context of the cue.

Method

Subjects. Seventy-two subjects, selected from the same pool as in Experiments 1 and 2 above, were divided into three groups of twenty-four each and tested individually.

Design and Materials. The same nouns, priming phrases, and attributes used in Experiment 2 above were used in this experiment as well (see Appendices E, F, and G). Greenspan (1984) selected the central properties of his nouns through recourse to a dictionary, the "central properties were always listed in the dictionary definition of the nouns." (p. 4). Along similar lines, Greenspan defined peripheral properties as those which did not appear in the

dictionary definition. While the former definition seems acceptable, if somewhat arbitrary, the latter has absolutely no constraints placed upon it all. For purposes of comparison with the Greenspan study, the current study defined the attribute most frequently generated for each word in Experiment 1 as a central attribute, while the remaining two attributes were labeled as peripheral attributes, insuring that all attributes were indeed appropriate attributes for the given word, a restriction not made clear in the Greenspan study. The labeling procedure was used on the basis that attributes which are more central to a word's meaning would more likely be generated than more peripheral attributes.

A BASIC computer program was written which would display first the noun and the the priming phrase on a CRT. The program further displayed a verification question of the form "Does A have B?" or Is A B?" in which "A" is the noun, and "B" one of the noun's attributes (see Table 2 for example). The attribute presented as "B" was always one of the three attributes used in Experiment 2. Each of the 18 nouns with each of its three priming phrases paired with each of the three possible target attributes for "B" in the

verification question were presented in this fashion. More simply, all three of each noun's priming phrases were presented paired with all three possible target attributes for a total of nine presentations per noun, or a total of 162 for all 18 nouns. The 162 presentations were divided into three lists of 54 presentations, such that no subject received more than one occurrence of each of a noun's priming phrases, nor more than one occurrence of each of a noun's target attributes. More specifically, by the end of the session, each subject had received, for each noun, a matched pair of priming phrase and an appropriate target attribute, as well as two mismatched pairs (a different priming phrase with a noncorresponding target attribute, see Table 3). The correct response to the verification questions for each of these presentations was always a positive "yes." In addition, 54 negative "dummy" presentations were included in each of the three lists, (also of the form "Does A have B?" or "Is A B?") created from the remaining nouns used in Experiment 1. The order of the total one hundred-eight presentations was randomized for each subject.

Procedure. Each subject was seated before an Apple II+ microcomputer and Zenith green monitor.

Subjects were informed, via instructions printed on the monitor, that they were taking part in a verification task. Specifically, they were told they would be presented with a word, a short sentence containing that word, and then asked a question about that word. Their task, they were told, would be to respond correctly as quickly as possible. The instructions explained that the answer to the question would either be true or false and indicated which keys to strike on the computer's keyboard to indicate their response. Subjects were questioned concerning their handedness, and the "true" was matched to their dominant hand. Subjects were given 15 practice presentations and then received one of the three lists of 108 presentations.

For each presentation the noun was presented at the top of the CRT, followed by a blank line and then the priming phrase. Three more blank lines then followed, and then, after an approximate two second delay, the verification question. All of the text on the screen was left-justified and remained there until the subject made a response. A timing mechanism began keeping time upon completion of printing the verification question and ended as soon as the subject responded either positively or negatively.

Reaction times for each word were averaged for each of the three counterbalanced groups, yielding nine mean responses per word. The anticipated result was a clear relationship between response time and the interaction of the two within-subjects variables (priming phrase and target attribute). Specifically, shorter response times were expected where the target attribute was rated as closer to the priming phrase, as scaled in Experiment 2, that is, as attributes are placed lower with respect to salience in a given context (priming phrase), they will require a greater amount of time to verify in a task based upon that context.

Results and Discussion

Of the original 18 nouns used, three nouns, and their requisite primes and cues, were dropped from the study due to ambiguous or inconsistent statements resulting from prime-cue pairings, e.g., for the prime: "THE SKY WAS CLEAR" the cue: "DOES THE SKY HAVE CLOUDS?" would in fact be false. The remaining 15 nouns were further broken down into their sets of three priming phrases or contexts. Each of the these 45 items contained subjects' response times to one of three different prime-cue combinations. A one-way

analysis of variance with unequal cell frequencies was performed on each of the forty-five items, with three levels of cue, one appropriate to the prime, and two inappropriate cues (see Table 3). Of the 45 tests performed, 22 were significant at the $p < .05$ level. However, when the reaction times were ranked in the predicted order obtained from the salience ratings of Experiment 2 (see Tables 4.1 through 4.15) only five of the 45 items produced the parallel ordering predicted, and of these five, only three contained significant differences. Serious consideration should be given to the possibility that this small handful of predicted results is the product of a very probable alpha error.

No consistent or systematic pattern of reaction times, as a function of the relationship between prime and appropriate cue, was found. This is contrary to the results observed in the Tabossi (1982) study, and those anticipated here. The actual results suggest that the attribute made salient by the priming phrase produces no observable effect (as measured by reaction times) on interpretation of the word, regardless of the context provided by the verification cue (i.e., appropriate or otherwise). However, these results do not provide support for a static meaning interpretation

either. If interpreted meaning were in fact remaining constant, then no variation in reaction time across different cues should be observed; this was the case for only 23 of the of the 45 reaction time analyses.

Likewise no main effect of central over peripheral cues were found as would be suggested by the Greenspan (1984) study. It should be noted however, that a different procedure was used in determining central and peripheral properties in the present study than was employed by Greenspan. Those attributes labeled as central to a given word's meaning did not systematically produce briefer reaction times, either within or across primes, and in some cases produced significantly slower reaction times. While the method of selection of central and peripheral properties differed from that employed by Greenspan, the method used still appears sound, replicable, and more empirically defensible than Greenspan's.

## GENERAL DISCUSSION

If we acknowledge the importance of context on our understanding of meaning, and its influence on our interpretation of unambiguous words, then any experiment which attempts to study semantic processes must begin by somehow establishing or determining which

aspects of meaning are salient in the given context. Such procedures, however, tend in previous research to be the exception rather than the norm. In the current studies Experiment 1 was performed to generate the actual attributes which would be used in the other two experiments. This experiment was performed explicitly in this study in part due to the conspicuous lack in similar studies. While many researchers report the source for part of the materials they use, such as one or another published word list, the origin of other materials such as the attributes being tested or the priming phrases employed are often not mentioned. Studies of semantics designed to provide some insight into our use of language should reflect natural language use, as revealed in the gathering of materials. Whether more contrived or convenient methods are in use in previous research can only be speculated, as evidence to the contrary is not commonly presented. Experiment 1 of the current research was performed to increase the controls on the materials used, by decreasing the likelihood of some systematic influence of the experimenter and his assistants in producing the materials themselves.

Experiment 2 was performed to provide salience rankings of various attributes in each of three contexts for the nouns being examined. Again, the ranking was performed experimentally rather than through some more arbitrary procedure such as utilizing dictionary definitions. The obtained results support the idea of semantic flexibility, as demonstrated by changes in attribute rankings across different contexts, and are consistent with the Variable Feature explanation that features, as measured experimentally by attributes, change in salience ratings as a function of context. This also provided a base-line to compare other measures, specifically reaction time data, against, with the not unreasonable prediction that results from other measures would parallel those obtained in Experiment 2. However, the totally idiosyncratic results from Experiment 3 appear to belie this idea. Not only were the results from the two measures non-parallel, but the more obvious relationship of swifter response times to appropriately primed cues was also lacking. Subjects produced reaction times for appropriately matched primes and cues which did not vary significantly from reaction

times resulting from inappropriately matched pairs, or which were even significantly higher.

Likewise the rather powerful effect found by Greenspan (1984) of swifter response times to cues using central attributes as compared to cues using peripheral attributes was also absent. It is conceivable that the different procedures used in labeling central and peripheral properties between the present study and Greenspan's experiment, and the subsequent variance in control may be responsible for these results.

The lack of results comparable with either the Tabossi or Greenspan studies is worth noting. Tabossi's results suggest a parallel to encoding specificity, that is, swifter reaction times are expected for appropriately matched priming attribute and cued attribute than for inappropriate matches. Greenspan's results parallel those obtained by Tabossi, but only with respect to peripheral properties. Reaction times to primed central properties did not differ significantly across appropriate or inappropriate central cues, or appropriate peripheral matches. That neither set of results was obtained by Experiment 3 is perhaps more striking than the

anticipated result of a replication of one of the two positions alone. It should be noted, that while in the Tabossi study each subject served as his/her own control by receiving each item twice, producing twice as many data points per subject, subjects in the current study received each item from their respective lists only once.

Perhaps the explanation of such disparate results can be found in Experiment 1. The nouns and attributes used in both Experiments 2 and 3 were generated by subjects during the first experiment. Neither Tabossi (1982) nor Greenspan (1984) state where their experimental materials originated, and it may be assumed that they were generated by the experimenters themselves. It is possible that by using materials generated by the procedure in Experiment 1 that some form of experimenter error was added to the studies in such a way as to render the results unintelligible. Along a similar line, as discussed above, the lack of an experimental procedure (such as used in Experiment 1) by other researchers may have resulted in some systematic effect, insuring some form of consistent but spurious results.

Another possible explanation for the results obtained in Experiment 3 can be found by examining the procedure used in Experiment 2, specifically the ordering method imposed upon subjects. By requiring subjects to order attributes consecutively without duplication or omission of the values one through five it is possible that an artifactual ranking may have occurred. Such an artifact would might in fact produce differently ranked attributes where, if subjects' ranking in Experiment 2 had been free to vary, no such significant difference might actually exist. However, while such an artifact might indeed disrupt the predicted order over three cues, it seems unlikely that it would have much effect upon central properties, as defined for use in this study. As noted earlier, no effect of central properties were observed.

Additionally, the procedure used in Experiment 3 may be suspect. Whereas subjects were presented with the noun, the priming phrase, and, after a delay, the cue it is possible that subjects used the initial noun as a prime, which would suggest that a default or core set of attributes were being activated. Likewise, it is not unreasonable to assume that subjects may have been ignoring both noun and priming phrase entirely,

and responded to the verification task based solely on the cue, which would likewise suggest the priming of central properties.

Still another possible explanation for the failure to obtain the predicted results may be traced to the different measures used in Experiments 2 and 3. The critical difference between the two procedures appears to be time. In Experiment 2 subjects were permitted to work at their own rate, taking approximately twenty minutes to rank all 18 words, each in its own context. On the other hand, clearly time is the crucial factor in a reaction time task such as in Experiment 3. Perhaps the rankings obtained in Experiment 2 are only possible when subjects have sufficient opportunity to deliberate, and as such have little or no bearing upon more rapid judgments of salience.

It is conceivable that the changes in salience of various attributes produced by the priming phrase are not sufficiently established or accessible in the brief period between prime and verification cue in Experiment 3. Such a possibility could easily be tested empirically by altering the procedure in Experiment 3 such that subjects received primes for all words, and only after this point were tested for reaction time to

verification cues. Even more simply, replicating Experiment 3 with a greater delay between presentation of priming phrase and cue should provide similar results if the interval is indeed critical. Clearly then, these and other followup experiments can and should be performed to further examine the effect of time in semantic flexibility.

Variable Feature Theory includes the notion that semantic flexibility is an ongoing process occurring over time. It is intuitively obvious that our understanding of a word is colored not only by the current context, but by our experience as well. This suggests the idea that experience provides us with a "core" meaning, what Greenspan might describe as the central meaning of a word, or what we could conceptualize as a word's default meaning, or likewise as the interpreted meaning in the absence of any other contextual cues. An important distinction between this and Greenspan's notion of the central/peripheral dichotomy is that Variable Feature Theory describes all features as existing on a continuum, as compared to Greenspan's sharply defined dichotomy. While the idea of a central or core meaning is intuitively appealing, there is no need to abandon the idea of continuous

flexibility. We can conceptualize words which possess two or more central properties, and in which one property is perceived as either more or less central than the other properties. Greenspan instead seems to suggest semantic flexibility only for peripheral properties, and a rigid, unchanging role for central properties. Like so many others, the distinction is one that can, and should, be tested empirically.

In all, further replications must be considered, both of the current study, and of previous research, utilizing better controls. Careful scrutiny must be given to prior semantic research which has made use of reaction time procedures but which have not established which interpretation of a word's meaning is being instantiated by subjects. Without performing some form of pretest (as done here with Experiment 2) which can measure the relative saliences of a word's attributes, a precise measure of the size of the effect found in a reaction time task is at best problematical. Different reaction times can be expected for the same word in response to the same question as a function of the priming phrase. A pretest which establishs salience ratings for variable features in specific contexts

produces a scale against which each item's reaction time can be measured, for each context tested.

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Appendix A

Nouns Used in Experiment 1

| | | |
|---|---|---|
| HILL | CHAIR | DOOR |
| POTATOES | WATER | INK |
| OCEAN | BARN | WINDOW |
| BOOK | EGGS | MILK |
| HANDKERCHIEF | ICE | SAND |
| CANDLES | STREET | PICNIC |
| CLOCK | BOOTS | CABBAGE |
| KNIFE | LUNCH | RAIN |
| HAIR | APPLES | FIREPLACE |
| FOOTBALL | CAT | BOTTLE |
| FOREST | MUD | AIRPLANE |
| ELEPHANT | SUN | BLACKBOARD |
| SKY | BUTTERFLY | KITE |
| ARMY | UMBRELLA | CARROTS |
| COWBOY | CHEESE | SNOW |
| DIME | CLOWN | PUMPKIN |
| CHIMNEY | ROPE | |

Appendix B

Nouns Used in Experiment 2

| | |
|---|---|
| DOOR | POTATOES |
| OCEAN | BOOK |
| EGGS | HANDKERCHIEF |
| ICE | CANDLES |
| PICNIC | CLOCK |
| MUD | ELEPHANT |
| SKY | BUTTERFLY |
| ARMY | DIME |
| PUMPKIN | CHIMNEY |

Appendix C

Attributes Used in Experiment 2

| | | |
|---|---|---|
| CAN OPEN | IS WOODEN | HAS A KNOB |
| IS RECTANGULAR | IS AN ENTRANCE | |
| ARE EDIBLE | HAVE A PEEL | GROW IN GROUND |
| ARE WHITE | HAVE EYES | |
| IS DEEP | IS BLUE | IS LARGE |
| IS SALTY | HAS FISH | |
| HAS PAGES | HAS COVERS | HAS WORDS |
| HAS A TITLE | MADE OF PAPER | |
| HAVE A YOLK | ARE OVAL | HAVE A SHELL |
| ARE BREAKABLE | ARE SLIMY | |
| IS CLOTH | IS SQUARE | USED TO BLOW NOSE |
| IS WHITE | IS ORNAMENTAL | |
| IS COLD | IS FROZEN WATER | CAN MELT |
| IS SOLID | IS CLEAR | |
| ARE WAX | GIVES LIGHT | ARE BURNT |
| ARE ROMANTIC | SMELL NICE | |

| | | |
|---|---|---|
| HAS FOOD | IS OUTDOOR | IS FUN |
| IS MESSY | HAS ANTS | |
| HAS TIME | HAS HANDS | HAS NUMBERS |
| TICKS | HAS AN ALARM | |
| IS BLACK | IS COLD | IS SQUISHY |
| IS WET | IS DIRTY | |
| IS GREY | IS BIG | HAS A TRUNK |
| HAS TUSKS | HAS LARGE EARS | |
| IS BLUE | HAS CLOUDS | IS ENDLESS |
| HAS STARS | IS ABOVE US | |
| IS AN INSECT | IS COLORFUL | FLUTTERS |
| IS SMALL | IS DELICATE | |
| HAS UNIFORMS | HAS WEAPONS | FIGHTS |
| PROTECTS | IS STRICT | |
| IS SILVER | IS ROUND | IS MONEY |
| IS SMALL | IS THIN | |
| IS ORANGE | HAS SEEDS | IS ROUND |
| IS EDIBLE | HAS A STEM | |

| | | |
|---|---|---|
| HAS BRICKS | HAS SMOKE | IS SOOTY |
| IS SQUARE | IS TALL | |

Appendix D

Priming Sentences Used in Experiment 2

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THE DOOR WAS LATCHED

THE DOOR IS VARNISHED

THE DOOR HAS HINGES

THE POTATOES WERE SCRUBBED

THE POTATOES WERE PLANTED

THE POTATOES TASTED GOOD

IT TAKES A LONGS TIME TO CROSS THE OCEAN

THE OCEAN REFLECTS THE SKY

THE OCEAN IS VIRTUALLY BOTTOMLESS

SHE FLIPPED THROUGH THE BOOK

THE BOOK WAS BOUND

THE BOOK CAN BE READ

HE LIKES HIS EGGS RUNNY

THE SCRAMBLED EGGS WERE CRUNCHY

THEY ROLLED THE EGGS

THE HANDKERCHIEF WAS SOFT

CARRY A HANDKERCHIEF WHEN YOU HAVE A COLD

THE HANDKERCHIEF WAS FOLDED

HE MADE ICE CUBES

HE DROPPED ICE CUBES INTO HIS LEMONADE

THE ICE DRIPPED

HE LIT THE CANDLES

THE CANDLES DRIPPED

THE CANDLES SHONE IN THE WINDOW

IT WAS A PERFECT DAY FOR A PICNIC

HE ATE TOO MUCH AT THE PICNIC

THEY ENJOYED THE PICNIC

IT WAS A DONALD DUCK ALARM CLOCK

HE LOOKED AT THE CLOCK TO SEE IF HE WAS LATE

IT WAS A DIGITAL CLOCK

THE MUD-PACK MADE HER SHIVER

THE MUD WAS DARK

THE MUD OOZED THROUGH HER TOES

THE ELEPHANT FILLED THE ROOM

ELEPHANTS ARE DRAB LOOKING

THE ELEPHANT SQUIRTED WATER

THE SKY WAS OVERCAST

THE SKY STRETCHES BEYOND THE HORIZON

THE SKY WAS CLEAR

BUTTERFLIES REMIND HIM OF FLOWERS

BUTTERFLIES WERE ONCE CATERPILLARS

THE BUTTERFLIES MOVED FROM FLOWER TO FLOWER

THE ARMY IS TRAINED FOR WARFARE

THE ARMY IS WELL TRAINED

EVERYONE IN THE ARMY DRESSES ALIKE

HE RECEIVED A DIME AS CHANGE

HE PUT THE DIMES INTO A ROLL

THE DIME WAS METAL

THEY ROLLED PUMPKINS DOWN THE HILL

THEY PLANTED PUMPKINS

THE PUMPKINS ARE BRIGHT

THE CHIMNEY HADN'T BEEN CLEANED IN A LONG TIME

THE CHIMNEY WAS RED

THE CHIMNEY'S FLUE WAS OPEN

---

Appendix E

Nouns Used in Experiment 3

| | |
|---|---|
| DOOR | POTATOES |
| OCEAN | BOOK |
| EGGS | HANDKERCHIEF |
| ICE | CANDLES |
| PICNIC | MUD |
| ELEPHANT | BUTTERFLY |
| DIME | PUMPKIN |
| CHIMNEY | |

Appendix F

Attributes Used in Experiment 3

| | | |
|---|---|---|
| CAN OPEN | IS WOODEN | HAS A KNOB |
| ARE EDIBLE | HAVE A PEEL | GROW IN GROUND |
| IS DEEP | IS BLUE | IS LARGE |
| HAS PAGES | HAS COVERS | HAS WORDS |
| HAVE A YOLK | ARE OVAL | HAVE A SHELL |
| IS CLOTH | IS SQUARE | USED TO BLOW NOSE |
| IS COLD | IS FROZEN WATER | CAN MELT |
| ARE WAX | GIVES LIGHT | ARE BURNT |
| HAS FOOD | IS OUTDOOR | IS FUN |
| IS BLACK | IS COLD | IS SQUISHY |
| IS GREY | IS BIG | HAS A TRUNK |
| IS AN INSECT | IS COLORFUL | FLUTTERS |
| IS SILVER | IS ROUND | IS MONEY |
| IS ORANGE | HAS SEEDS | IS ROUND |
| HAS BRICKS | HAS SMOKE | IS SOOTY |

Appendix G

Priming Sentences Used in Experiment 3

---

THE DOOR WAS LATCHED

THE DOOR IS VARNISHED

THE DOOR HAS HINGES

THE POTATOES WERE SCRUBBED

THE POTATOES WERE PLANTED

THE POTATOES TASTED GOOD

IT TAKES A LONGS TIME TO CROSS THE OCEAN

THE OCEAN REFLECTS THE SKY

THE OCEAN IS VIRTUALLY BOTTOMLESS

SHE FLIPPED THROUGH THE BOOK

THE BOOK WAS BOUND

THE BOOK CAN BE READ

HE LIKES HIS EGGS RUNNY

THE SCRAMBLED EGGS WERE CRUNCHY

THEY ROLLED THE EGGS

THE HANDKERCHIEF WAS SOFT

CARRY A HANDKERCHIEF WHEN YOU HAVE A COLD

THE HANDKERCHIEF WAS FOLDED

HE MADE ICE CUBES

HE DROPPED ICE CUBES INTO HIS LEMONADE

THE ICE DRIPPED

HE LIT THE CANDLES

THE CANDLES DRIPPED

THE CANDLES SHONE IN THE WINDOW

IT WAS A PERFECT DAY FOR A PICNIC

HE ATE TOO MUCH AT THE PICNIC

THEY ENJOYED THE PICNIC

THE MUD-PACK MADE HER SHIVER

THE MUD WAS DARK

THE MUD OOZED THROUGH HER TOES

THE ELEPHANT FILLED THE ROOM

ELEPHANTS ARE DRAB LOOKING

THE ELEPHANT SQUIRTED WATER

BUTTERFLIES REMIND HIM OF FLOWERS

BUTTERFLIES WERE ONCE CATERPILLARS

THE BUTTERFLIES MOVED FROM FLOWER TO FLOWER

HE RECEIVED A DIME AS CHANGE

HE PUT THE DIMES INTO A ROLL

THE DIME WAS METAL

THEY ROLLED PUMPKINS DOWN THE HILL

THEY PLANTED PUMPKINS

THE PUMPKINS ARE BRIGHT

THE CHIMNEY HADN'T BEEN CLEANED IN A LONG TIME

THE CHIMNEY WAS RED

THE CHIMNEY'S FLUE WAS OPEN

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Table 1

Practice Examples Presented to Experiment 2 Subjects

| | | | | |
|---|---|---|---|---|
| WATER | | | | |
| HE SAW THE TINY FISH SWIMMING IN THE WATER | | | | |
| IS WET | IS CLEAR | IS DRUNK | IS A LIQUID | IS COOL |
| 3 | 1 | 5 | 2 | 4 |
| WATER | | | | |
| SHE WAS VERY THIRSTY | | | | |
| IS WET | IS CLEAR | IS DRUNK | IS A LIQUID | IS COOL |
| 3 | 5 | 1 | 4 | 2 |

Table 2.1

Mean Salience Ratings from Experiment 2: DOOR

(1) THE DOOR WAS LATCHED

(2) THE DOOR IS VARNISHED

(3) THE DOOR HAS HINGES

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS AN ENTRANCE | 2.30 | 2.65 | 2.75 |
| IS RECTANGULAR | 4.30 | 3.85 | 3.75 |
| HAS A KNOB | 2.25 | 3.00 | 3.35 |
| IS WOODEN | 4.10 | 3.85 | 1.55 |
| CAN OPEN | 2.05 | 1.65 | 3.60 |

$F(4,57) = 34$, $p < .001$.

Table 2.2

Mean Salience Ratings from Experiment 2: POTATOES

(1) THE POTATOES WERE SCRUBBED

(2) THE POTATOES WERE PLANTED

(3) THE POTATOES TASTED GOOD

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| GROW IN GROUND | 2.30 | 3.35 | 1.15 |
| HAVE A PEEL | 2.55 | 2.85 | 3.30 |
| ARE EDIBLE | 2.25 | 1.35 | 2.75 |
| HAVE EYES | 4.35 | 4.35 | 3.70 |
| ARE WHITE | 3.55 | 3.10 | 4.10 |

$F(4,57) = 10$, $p < .001$.

Table 2.3

Mean Salience Ratings from Experiment 2: OCEAN

(1) IT TAKES A LONGS TIME TO CROSS THE OCEAN

(2) THE OCEAN REFLECTS THE SKY

(3) THE OCEAN IS VIRTUALLY BOTTOMLESS

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS LARGE | 1.30 | 2.30 | 2.20 |
| IS BLUE | 3.85 | 3.30 | 1.55 |
| IS DEEP | 2.00 | 1.20 | 2.75 |
| HAS FISH | 4.40 | 4.05 | 4.70 |
| IS SALTY | 3.45 | 4.30 | 3.80 |

$F(4,57) = 2$, $p < .08$.

Table 2.4

Mean Salience Ratings from Experiment 2: BOOK

(1) SHE FLIPPED THROUGH THE BOOK

(2) THE BOOK WAS BOUND

(3) THE BOOK CAN BE READ

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| HAS WORDS | 2.75 | 1.25 | 4.55 |
| HAS COVERS | 3.70 | 4.30 | 2.85 |
| HAS PAGES | 1.80 | 3.45 | 3.00 |
| HAS A TITLE | 3.55 | 2.45 | 2.50 |
| MADE OF PAPER | 3.20 | 3.55 | 2.10 |

$F(4,57) = 30$, $p < .001$.

Table 2.5

Mean Salience Ratings from Experiment 2: EGGS

(1) HE LIKES HIS EGGS RUNNY

(2) THE SCRAMBLED EGGS WERE CRUNCHY

(3) THEY ROLLED THE EGGS

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| HAVE A SHELL | 3.65 | 1.95 | 1.45 |
| ARE OVAL | 4.40 | 1.30 | 3.85 |
| HAVE A YOLK | 1.95 | 3.90 | 3.05 |
| ARE BREAKABLE | 3.20 | 2.95 | 2.60 |
| ARE SLIMY | 1.80 | 4.90 | 4.05 |
| | $F(4,57) = 59$, $p < .001$ | | |

Table 2.6

Mean Salience Ratings from Experiment 2: HANDKERCHIEF

(1) THE HANDKERCHIEF WAS SOFT

(2) CARRY A HANDKERCHIEF WHEN YOU HAVE A COLD

(3) THE HANDKERCHIEF WAS FOLDED

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| USED TO BLOW NOSE | 2.05 | 3.65 | 1.15 |
| IS SQUARE | 3.50 | 2.25 | 3.40 |
| IS CLOTH | 1.55 | 2.00 | 2.05 |
| IS ORNAMENTAL | 4.65 | 3.65 | 4.70 |
| IS WHITE | 3.25 | 3.45 | 3.70 |

$F(4,57) = 2$, $p < .08$.

Table 2.7

Mean Salience Ratings from Experiment 2: ICE

(1) HE MADE ICE CUBES

(2) HE DROPPED ICE CUBES INTO HIS LEMONADE

(3) THE ICE DRIPPED

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| CAN MELT | 4.50 | 1.85 | 4.20 |
| IS FROZEN WATER | 1.65 | 2.45 | 2.30 |
| IS COLD | 2.20 | 3.20 | 1.50 |
| IS CLEAR | 4.20 | 3.75 | 4.10 |
| IS SOLID | 2.45 | 3.75 | 2.90 |

$F(4,57) = 29$, $p < .001$.

Table 2.8

Mean Salience Ratings from Experiment 2: CANDLES

(1) HE LIT THE CANDLES

(2) THE CANDLES DRIPPED

(3) THE CANDLES SHONE IN THE WINDOW

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| ARE BURNT | 2.65 | 2.60 | 2.05 |
| GIVE LIGHT | 1.75 | 1.45 | 2.85 |
| ARE WAX | 3.00 | 3.40 | 1.50 |
| SMELL NICE | 3.85 | 4.20 | 4.05 |
| ARE ROMANTIC | 3.75 | 3.35 | 4.55 |

$F(4,57) = 4$, $p < .01$.

Table 2.9

Mean Salience Ratings from Experiment 2: PICNIC

(1) IT WAS A PERFECT DAY FOR A PICNIC

(2) HE ATE TOO MUCH AT THE PICNIC

(3) THEY ENJOYED THE PICNIC

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS FUN | 2.10 | 2.60 | 2.80 |
| IS OUTDOOR | 1.75 | 1.80 | 2.50 |
| HAS FOOD | 2.35 | 1.80 | 1.35 |
| HAS ANTS | 4.70 | 5.00 | 4.55 |
| IS MESSY | 4.10 | 3.80 | 3.80 |

$F(4,57) = 3$, $p < .05$.

Table 2.10

Mean Salience Ratings from Experiment 2: CLOCK

(1) IT WAS A DONALD DUCK ALARM CLOCK

(2) HE LOOKED AT THE CLOCK TO SEE IF HE WAS LATE

(3) IT WAS A DIGITAL CLOCK

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| HAS NUMBERS | 3.35 | 1.45 | 2.75 |
| HAS HANDS | 3.85 | 4.25 | 3.30 |
| HAS TIME | 1.75 | 1.90 | 1.10 |
| HAS AN ALARM | 2.60 | 3.35 | 4.10 |
| TICKS | 3.45 | 4.05 | 3.75 |

$F(4,57) = 48$, $p < .001$.

Table 2.11

Mean Salience Ratings from Experiment 2: MUD

(1) THE MUD-PACK MADE HER SHIVER

(2) THE MUD WAS DARK

(3) THE MUD OOZED THROUGH HER TOES

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS SQUISHY | 2.65 | 1.40 | 3.90 |
| IS COLD | 1.90 | 3.75 | 4.00 |
| IS BLACK | 4.30 | 4.00 | 1.40 |
| IS DIRTY | 3.40 | 3.35 | 2.35 |
| IS WET | 2.75 | 2.50 | 3.35 |

$F(4,57) = 16$, $p < .001$.

Table 2.12

Mean Salience Ratings from Experiment 2: ELEPHANT

(1) THE ELEPHANT FILLED THE ROOM

(2) ELEPHANTS ARE DRAB LOOKING

(3) THE ELEPHANT SQUIRTED WATER

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| HAS A TRUNK | 2.80 | 1.30 | 3.20 |
| IS BIG | 1.15 | 2.40 | 2.45 |
| IS GREY | 4.35 | 3.95 | 1.65 |
| HAS TUSKS | 3.85 | 3.80 | 4.40 |
| HAS LARGE EARS | 2.85 | 3.55 | 3.30 |

$F(4,57) = 39$, $p < .001$.

Table 2.13

Mean Salience Ratings from Experiment 2: SKY

(1) THE SKY WAS OVERCAST

(2) THE SKY STRETCHES BEYOND THE HORIZON

(3) THE SKY WAS CLEAR

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS ENDLESS | 3.85 | 2.60 | 1.30 |
| HAS CLOUDS | 1.75 | 3.80 | 4.00 |
| IS BLUE | 3.35 | 2.45 | 3.10 |
| IS ABOVE US | 1.95 | 2.75 | 2.15 |
| HAS STARS | 4.10 | 3.40 | 4.45 |

$F(4,57) = 16$, $p < .001$.

Table 2.14

Mean Salience Ratings from Experiment 2: BUTTERFLIES

(1) BUTTERFLIES REMIND HIM OF FLOWERS

(2) BUTTERFLIES WERE ONCE CATERPILLARS

(3) THE BUTTERFLIES MOVED FROM FLOWER TO FLOWER

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| FLUTTERS | 3.40 | 1.70 | 3.90 |
| IS COLORFUL | 1.55 | 3.40 | 3.45 |
| IS AN INSECT | 4.00 | 2.85 | 1.45 |
| IS DELICATE | 2.50 | 3.30 | 3.10 |
| IS SMALL | 3.55 | 3.75 | 3.10 |

$F(4,57) = 79$, $p < .001$.

Table 2.15

Mean Salience Ratings from Experiment 2: ARMY

(1) THE ARMY IS TRAINED FOR WARFARE

(2) THE ARMY IS WELL TRAINED

(3) EVERYONE IN THE ARMY DRESSES ALIKE

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| PROTECTS | 2.15 | 3.55 | 2.10 |
| IS STRICT | 3.60 | 2.45 | 2.50 |
| HAS UNIFORMS | 4.35 | 1.25 | 4.55 |
| FIGHTS | 1.95 | 4.30 | 2.85 |
| HAS WEAPONS | 2.95 | 3.45 | 3.00 |
| | $F(4,57) = 13$, $p < .001$. | | |

Table 2.16

Mean Salience Ratings from Experiment 2: DIME

(1) HE RECEIVED A DIME AS CHANGE

(2) HE PUT THE DIMES INTO A ROLL

(3) THE DIME WAS METAL

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS MONEY | 1.30 | 2.35 | 3.00 |
| IS ROUND | 3.65 | 3.60 | 1.65 |
| IS SILVER | 3.00 | 1.30 | 4.25 |
| IS THIN | 3.80 | 3.75 | 3.00 |
| IS SMALL | 3.25 | 3.85 | 3.10 |

$F(4,57) = 28$, $p < .001$.

Table 2.17

Mean Salience Ratings from Experiment 2: PUMPKINS

(1) THEY ROLLED PUMPKINS DOWN THE HILL

(2) THEY PLANTED PUMPKINS

(3) THE PUMPKINS ARE BRIGHT

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS ROUND | 1.20 | 2.20 | 3.70 |
| HAS SEEDS | 3.80 | 3.80 | 1.60 |
| IS ORANGE | 2.40 | 1.10 | 3.05 |
| HAS A STEM | 3.45 | 3.65 | 3.00 |
| IS EDIBLE | 4.15 | 4.25 | 3.65 |

$F(4,57) = 26$, $p < .001$.

Table 2.18

Mean Salience Ratings from Experiment 2: CHIMNEY

(1) THE CHIMNEY HADN'T BEEN CLEANED IN A LONG TIME

(2) THE CHIMNEY WAS RED

(3) THE CHIMNEY'S FLUE WAS OPEN

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| IS SOOTY | 1.60 | 2.65 | 4.00 |
| HAS SMOKE | 2.15 | 1.60 | 3.30 |
| HAS BRICKS | 3.30 | 3.40 | 1.05 |
| IS TALL | 3.55 | 3.65 | 3.25 |
| IS SQUARE | 4.40 | 3.70 | 3.40 |

$F(4,57) = 11$, $p < .001$.

Table 3

Examples of Prime-Cue Combinations from Experiment 3

| |
|---|
| (i) primed attribute matched with cued attribute |
| ELEPHANT |
| THE ELEPHANT FILLED THE ROOM |
| ARE ELEPHANTS BIG? |
| (ii) primed attribute not matched with cued attribute |
| ELEPHANT |
| THE ELEPHANT SQUIRTED WATER |
| ARE ELEPHANTS GREY? |
| ELEPHANT |
| ELEPHANTS ARE DRAB LOOKING |
| DO ELEPHANTS HAVE TRUNKS? |

Table 4.1

Mean Reaction Times from Experiment 3: DOOR

Primes

(1) THE DOOR WAS LATCHED

(2) THE DOOR IS VARNISHED

(3) THE DOOR HAS HINGES

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| KNOB | 1.84 (2.25) | 1.95 (3.00) | 2.10 (3.35) |
| WOODEN | 1.78 (4.10) | 1.90 (3.85) | 1.65 (1.55) |
| OPENS | 2.19 (2.05) | 1.50 (1.65) | 1.16 (3.60) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.2

Mean Reaction Times from Experiment 3: POTATOES

Primes

(1) THE POTATOES WERE SCRUBBED

(2) THE POTATOES WERE PLANTED

(3) THE POTATOES TASTED GOOD

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| GROUND | 2.55 (2.30) | 2.32 (3.35) | 1.73 (1.15) |
| PEEL | 1.65 (2.55) | 2.06 (2.85) | 1.92 (3.30) |
| EDIBLE | 1.61 (2.25) | 1.50 (1.35) | 1.96 (2.75) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.3

Mean Reaction Times from Experiment 2: OCEAN

Primes

(1) IT TAKES A LONGS TIME TO CROSS THE OCEAN

(2) THE OCEAN REFLECTS THE SKY

(3) THE OCEAN IS VIRTUALLY BOTTOMLESS

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| LARGE | 2.13 (1.30) | 2.02 (2.30) | 1.72 (2.20) |
| BLUE | 1.83 (3.85) | 1.56 (3.30) | 2.09 (1.55) |
| DEEP | 1.59 (2.00) | 1.98 (1.20) | 1.80 (2.75) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.4

Mean Reaction Times from Experiment 3: BOOK

Primes

(1) SHE FLIPPED THROUGH THE BOOK

(2) THE BOOK WAS BOUND

(3) THE BOOK CAN BE READ

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| WORDS | 2.13 (2.75) | 1.66 (1.25) | 1.74 (4.55) |
| COVERS | 1.88 (3.70) | 2.02 (4.30) | 1.72 (2.85) |
| PAGES | 1.75 (1.80) | 1.86 (3.45) | 1.99 (3.00) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.5

Mean Reaction Times from Experiment 3: EGGS

Primes

(1) HE LIKES HIS EGGS RUNNY

(2) THE SCRAMBLED EGGS WERE CRUNCHY

(3) THEY ROLLED THE EGGS

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| SHELL | 2.15 (3.65) | 1.97 (1.95) | 1.63 (1.45) |
| OVAL | 1.98 (4.40) | 1.78 (1.30) | 2.26 (3.85) |
| YOLK | 1.52 (1.95) | 1.94 (3.90) | 1.55 (3.05) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.6

Mean Reaction Times from Experiment 3: HANDKERCHIEF

Primes

(1) THE HANDKERCHIEF WAS SOFT

(2) CARRY A HANDKERCHIEF WHEN YOU HAVE A COLD

(3) THE HANDKERCHIEF WAS FOLDED

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| NOSE | 2.29 (2.05) | 2.32 (3.65) | 1.99 (1.15) |
| SQUARE | 2.00 (3.50) | 2.08 (2.25) | 2.13 (3.40) |
| CLOTH | 1.92 (1.55) | 2.59 (2.00) | 1.67 (2.05) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.7

Mean Reaction Times from Experiment 3: ICE

Primes

(1) HE MADE ICE CUBES

(2) HE DROPPED ICE CUBES INTO HIS LEMONADE

(3) THE ICE DRIPPED

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| MELT | 1.73 (4.50) | 1.58 (1.85) | 1.50 (4.20) |
| WATER | 1.77 (1.65) | 2.37 (2.45) | 2.52 (2.30) |
| COLD | 1.62 (2.20) | 1.98 (3.20) | 1.37 (1.50) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.8

Mean Reaction Times from Experiment 3: CANDLES

Primes

(1) HE LIT THE CANDLES

(2) THE CANDLES DRIPPED

(3) THE CANDLES SHONE IN THE WINDOW

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| BURNT | 1.86 (2.65) | 2.44 (2.60) | 2.15 (2.05) |
| LIGHT | 1.76 (1.75) | 1.68 (1.45) | 2.08 (2.85) |
| WAX | 2.21 (3.00) | 1.59 (3.40) | 1.76 (1.50) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.9

Mean Reaction Times from Experiment 3: PICNIC

Primes

(1) IT WAS A PERFECT DAY FOR A PICNIC

(2) HE ATE TOO MUCH AT THE PICNIC

(3) THEY ENJOYED THE PICNIC

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| FUN | 1.62 (2.10) | 2.00 (2.60) | 1.40 (2.80) |
| OUTDOOR | 2.11 (1.75) | 2.14 (1.80) | 1.65 (2.50) |
| FOOD | 1.88 (2.35) | 1.59 (1.80) | 2.08 (1.35) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.10

Mean Reaction Times from Experiment 3: MUD

Primes

(1) THE MUD-PACK MADE HER SHIVER

(2) THE MUD WAS DARK

(3) THE MUD OOZED THROUGH HER TOES

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| SQUISHY | 1.69 (2.65) | 1.85 (1.40) | 1.59 (3.90) |
| COLD | 3.09 (1.90) | 1.76 (3.75) | 1.94 (4.00) |
| BLACK | 1.97 (4.30) | 1.52 (4.00) | 1.94 (1.40) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.11

Mean Reaction Times from Experiment 3: ELEPHANT

Primes

(1) THE ELEPHANT FILLED THE ROOM

(2) ELEPHANTS ARE DRAB LOOKING

(3) THE ELEPHANT SQUIRTED WATER

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| TRUNK | 1.66 (2.80) | 2.31 (1.30) | 1.80 (3.20) |
| BIG | 2.09 (1.15) | 1.72 (2.40) | 1.39 (2.45) |
| GREY | 1.70 (4.35) | 1.52 (3.95) | 2.04 (1.65) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.12

Mean Reaction Times from Experiment 3: BUTTERFLIES

Primes

(1) BUTTERFLIES REMIND HIM OF FLOWERS

(2) BUTTERFLIES WERE ONCE CATERPILLARS

(3) THE BUTTERFLIES MOVED FROM FLOWER TO FLOWER

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| FLUTTERS | 1.94 (3.40) | 2.39 (1.70) | 1.72 (3.90) |
| COLORFUL | 2.48 (1.55) | 1.71 (3.40) | 1.68 (3.45) |
| INSECT | 2.22 (4.00) | 2.14 (2.85) | 2.38 (1.45) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.13

Mean Reaction Times from Experiment 3: DIME

Primes

(1) HE RECEIVED A DIME AS CHANGE

(2) HE PUT THE DIMES INTO A ROLL

(3) THE DIME WAS METAL

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| MONEY | 1.58 (1.30) | 1.55 (2.35) | 1.86 (3.00) |
| ROUND | 1.69 (3.65) | 1.95 (3.60) | 1.35 (1.65) |
| SILVER | 2.28 (3.00) | 1.87 (1.30) | 1.71 (4.25) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.14

Mean Reaction Times from Experiment 3: PUMPKINS

Primes

(1) THEY ROLLED PUMPKINS DOWN THE HILL

(2) THEY PLANTED PUMPKINS

(3) THE PUMPKINS ARE BRIGHT

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| ROUND | 1.85 (1.20) | 1.67 (2.20) | 1.78 (3.70) |
| SEEDS | 1.57 (3.80) | 2.04 (3.80) | 1.64 (1.60) |
| ORANGE | 1.93 (2.40) | 1.63 (1.10) | 1.52 (3.05) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

Table 4.15

Mean Reaction Times from Experiment 3: CHIMNEY

Primes

(1) THE CHIMNEY HADN'T BEEN CLEANED IN A LONG TIME

(2) THE CHIMNEY WAS RED

(3) THE CHIMNEY'S FLUE WAS OPEN

| | Prime | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Cue | | | |
| SOOTY | 2.24 (1.60) | 2.53 (2.65) | 1.77 (4.00) |
| SMOKE | 1.93 (2.15) | 2.00 (1.60) | 2.45 (3.30) |
| BRICKS | 2.59 (3.30) | 1.63 (3.40) | 1.99 (1.05) |

Note. Items in parentheses are the corresponding salience ratings from Experiment 2, for each respective prime/cue pairing.

# CHANGES IN CONTEXT AS A MEASURE OF SEMANTIC FLEXIBILITY

by

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ABSTRACT

Traditionally, psychological studies of semantics have contained the tacit understanding that, for any given item, meaning is fixed, and that components which comprise that meaning are discrete. The present study examines meaning using a system of continuous semantic features, which allows weighting of an item's semantic componenets relative to its use, as determined by context. The study demonstrates that the salience of an item's attributes varies as a function of context, and implies that a similar process is occurring at the underlying level of semantic features, i.e., that a feature which in one context is vital to an item's meaning may be far less salient in another context. A variable feature theory making use of continuous semantic features, existing in a state of flux, is proposed to describe this process.